

CLAIMS

We claim:

1. A method of processing a video sequence comprised of a plurality of frames to determine a number of bidirectional motion compensated (B) frames to be encoded in a set of successive frames in the plurality of frames, the method comprising:
 - a) computing motion vectors for at least one frame in the set of successive frames;
 - b) determining a motion cost value for at least one frame in the set of successive frames;
 - c) determining a derived cost value based on the motion cost value for at least one frame in the set of successive frames; and
 - d) determining the number of B-frames to be encoded in the set of successive frames based on the derived cost value.
 2. The method of claim 1 wherein the motion cost value of a frame is related to the number of bits required to encode the motion vectors of the frame.
 3. The method of claim 2 further comprising, after step a) and before step b):
computing motion compensation errors (MCEs) for at least one frame in the set of successive frames, wherein the motion cost value of a frame is related to the number of bits required to encode the motion vectors and the MCEs of the frame.
 4. The method of claim 1 wherein:
step b) comprises determining a motion cost value for a first and second frame in the set of successive frames; and
the derived cost value is the average of the motion cost values for the first and second frames.
 5. The method of claim 1 wherein:
step b) comprises determining a motion cost value for a first and second frame in the set of successive frames; and

the derived cost value is a ratio between the motion cost value of the first frame and the motion cost value of the second frame.

6. The method of claim 1 wherein step d) comprises comparing the derived cost value to a predetermined threshold value to determine the number of B-frames to be encoded in the set of successive frames, wherein the number of B-frames to be encoded increases as long as the derived cost value is below the predetermined threshold value.
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7. The method of claim 6 wherein the predetermined threshold value varies as the number of B-frames to be encoded increases.
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8. A method of encoding a video sequence in two passes, the video sequence being comprised of a plurality of frames, the method comprising:
 - a) performing a first pass of operations on a set of successive frames of the plurality of frames, the first pass of operations comprising:
 - computing motion vectors for at least one frame in the set of successive frames; and
 - determining a motion cost value for at least one frame in the set of successive frames;
 - determining a derived cost value based on the motion cost value for at least one frame in the set of successive frames; and
 - determining a number of bidirectional motion compensated (B) frames to be encoded in the set of successive frames based on the derived cost value; and
 - b) performing a second pass of operations on the set of successive frames, the second pass of operations comprising:
 - encoding the determined number of frames in the set of successive frames as B-frames by using at least one motion vector computed in step a).
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9. The method of claim 8 wherein the motion cost value of a frame is related to the number of bits required to encode the motion vectors of the frame.

10. The method of claim 8 wherein:

5 step a) comprises determining a motion cost value for a first and second frame in the set of successive frames; and

the derived cost value is the average of the motion cost values for the first and second frames.

10 11. The method of claim 8 wherein:

step a) comprises determining a motion cost value for a first and second frame in the set of successive frames; and

the derived cost value is a ratio between the motion cost value of the first frame and the motion cost value of the second frame.

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12. The method of claim 8 wherein step a) comprises computing motion vectors for a first and second frame in the set of successive frames, the motion vectors for the first frame being computed using information from a preceding frame and the motion vectors for the second frame being computed using information from the same preceding frame.

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13. The method of claim 12 wherein all of the motion vectors computed in step a) are used in step b).

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14. The method of claim 8 wherein step b) further comprises encoding the next frame in the set of successive frames after the B-frames as a P-frame.

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15. A method of detecting scene cuts in a video sequence comprised of a plurality of frames, the method comprising:

a) computing motion vectors for a first frame and a second frame in the plurality of frames;

- b) determining a motion cost value for the first frame and the second frame;
 - c) determining a ratio between the motion cost value of the first frame and the motion cost value of the second frame; and
 - d) determining if there is a scene cut between the first frame and the second frame based on the ratio.

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16. The method of claim 15 wherein a scene cut is a point in time when the content in the video sequence is discontinuous.

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17. The method of claim 15 wherein the motion cost value of the first frame is related to the number of bits required to encode the motion vectors of the first frame and the motion cost value of the second frame is related to the number of bits required to encode the motion vectors of the second frame.

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18. The method of claim 15 wherein step d) comprises determining if the ratio is less than a predetermined threshold value.

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- e) marking the first frame as a frame immediately after a scene cut and the second frame as a frame immediately before the scene cut if it is determined that the ratio is not less than a predetermined threshold value.

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21. A computer program product having a computer readable medium having computer program instructions recorded thereon for processing a video sequence comprised of a plurality of frames to determine a number of bidirectional motion compensated (B) frames to be encoded in a set of successive frames in the plurality of frames, the computer program product comprising:

- instructions for computing motion vectors for at least one frame in the set of successive frames;
- instructions for determining a motion cost value for at least one frame in the set of successive frames;
- 5 instructions for determining a derived cost value based on the motion cost value for at least one frame in the set of successive frames; and
- instructions for determining the number of B-frames to be encoded in the set of successive frames based on the derived cost value.
- 10 22. The computer program product of claim 21 wherein the motion cost value of a frame is related to the number of bits required to encode the motion vectors of the frame.
23. The computer program product of claim 21 wherein:
- the instructions for determining a motion cost value for at least one frame in the set of successive frames comprises instructions for determining a motion cost value for a first and second frame in the set of successive frames; and
- the derived cost value is a ratio between the motion cost value of the first frame and the motion cost value of the second frame.
- 20 24. The computer program product of claim 21 wherein the instructions for determining the number of B-frames comprises instructions for comparing the derived cost value to a predetermined threshold value to determine the number of B-frames to be encoded in the set of successive frames, wherein the number of B-frames to be encoded increases as long as the derived cost value is below the predetermined threshold value.
- 25 25. A computer program product having a computer readable medium having computer program instructions recorded thereon for encoding a video sequence in two passes, the video sequence being comprised of a plurality of frames, the computer program product comprising:

instructions for performing a first pass of operations on a set of successive frames of the plurality of frames, the instructions for performing the first pass of operations comprising:

5 instructions for computing motion vectors for at least one frame in the set of successive frames;

instructions for determining a motion cost value for at least one frame in the set of successive frames;

instructions for determining a derived cost value based on the motion cost value for at least one frame in the set of successive frames; and

10 instructions for determining a number of bidirectional motion

compensated (B) frames to be encoded in the set of successive frames based on the derived cost value; and

instructions for performing a second pass of operations on the set of successive frames, the instructions for performing the second pass of operations comprising:

15 instructions for encoding the determined number of frames in the set of successive frames as B-frames by using at least one motion vector computed by instructions performing the first pass of operations.

26. The computer program product of claim 25 wherein the motion cost value of a frame is
20 related to the number of bits required to encode the motion vectors of the frame.

27. The computer program product of claim 25 wherein the instructions for computing motion vectors comprises instructions for computing motion vectors for a first and second frame in the set of successive frames, the motion vectors for the first frame being
25 computed using information from a preceding frame and the motion vectors for the second frame being computed using information from the same preceding frame.

28. The computer program product of claim 25 wherein all of the motion vectors computed
30 by the instructions performing the first pass of operations are used by the instructions
 performing the second pass of operations.

29. A computer program product having a computer readable medium having computer program instructions recorded thereon for detecting scene cuts in a video sequence comprised of a plurality of frames, the computer program product comprising:

5 instructions for computing motion vectors for a first frame and a second frame in the plurality of frames;

instructions for determining a motion cost value for the first frame and the second frame;

10 instructions for determining a ratio between the motion cost value of the first frame and the motion cost value of the second frame; and

instructions for determining if there is a scene cut between the first frame and the second frame based on the ratio.

30. The computer program product of claim 29 wherein the motion cost value of the first frame is related to the number of bits required to encode the motion vectors of the first frame and the motion cost value of the second frame is related to the number of bits required to encode the motion vectors of the second frame.

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